Handout 10 Solutions

Topics

- Monopoly
- Selective exam questions, review

Monopoly Exercises

Exercise 1 A monopoly firm operates under cost structure and faces with market demand as summarized by the information in the below table.

Quantity	Price	Total Revenue	Marginal Revenue	Total Cost	Marginal Cost
0	200	0	-	100	-
1	180	**180**	**180**	130	**30**
2	170	**340**	**160**	170	**40**
3	160	**480**	**140**	**220**	50
4	**150**	600	120	**280**	60
5	140	**700**	100	**350**	70
6	**130**	780	**80**	430	**80**
7	**120**	840	**60**	520	**90**
8	**100**	800	**40**	620	**100**

1. Complete the missing values in this table. What is the profit maximizing level of output? What is the profit-maximizing profit?

   Solution: A profit maximizing firm will choose MC=MR. From the table MC=MR when Q=6. At this production level, $\pi = TR - TC = 780 - 430 = 350$

2. What is the social desirable output and price? How much profit does firm get under this socially desirable outcome?

   Solution: The socially desirable outcome can be implemented through a competitive market. At a competitive market P=MC. Therefore, P=100, Q=8. At Q=8, $\pi = TR - TC = 800 - 620 = 180$.

Exercise 2

Consider a monopoly that produces widgets. Suppose you are told that the monopoly has the following cost curves where TC is total cost measured in dollars, Q is the quantity of widgets, and P is the price per widget in dollars and the following demand curve:

$$TC = 4 + 4Q + Q^2$$
$$MC = 4 + 2Q$$
$$P = 19 - (1/2)Q_D$$

1. Given the above information, what is this monopolist's equation for MR?

   Solution: The monopolist's MR curve has the same y-intercept as the firm's demand curve and for a linear demand curve, has a slope that is twice the slope of the demand curve. The monopolist is the only firm in the market so the market demand curve is the monopolist's demand curve. Thus, the monopolist's MR curve can be written as $MR = 19 - Q$.

2. Determine the profit maximizing level of production for this monopolist as well as the price that will be charged for each unit of the good. Assume that this is a single price monopolist, i.e. the monopolist cannot engage in price discrimination. Explain how you found your answer.

   Solution: The profit maximizing amount of output for the monopolist is that level of output where $MR = MC$.
   Thus, $19–Q = 4 + 2Q \implies 15 = 3Q \implies Q = 5$ *widgets.*
   The price the monopolist will charge can be found by plugging in the profit maximizing quantity into the demand curve.
   Thus, $P = 19 - (1/2)(5) = \$16.50$ *per widget.*

3. Given the above information and your answer in (2) calculate the level of profit in the short- run for this monopolist. Explain how you found your answer.

   Solution: To find the monopolist's profit we need to calculate the monopolist's total revenue and its total cost:
   $TR = P * Q = (\$16.50$ *per widget*$) * (5$ *widgets*$) = \$82.50$
   $TC = 4 + 4Q + Q^2 = 4 + 4 * 5 + 5^2 = 4 + 20 + 25 = \$49$
   Profit for the monopolist $= TR–TC = \$82.50 - \$49.00 = \$33.50$

4. Given your answer in (3), what do you predict will happen to this monopolist in the long-run?

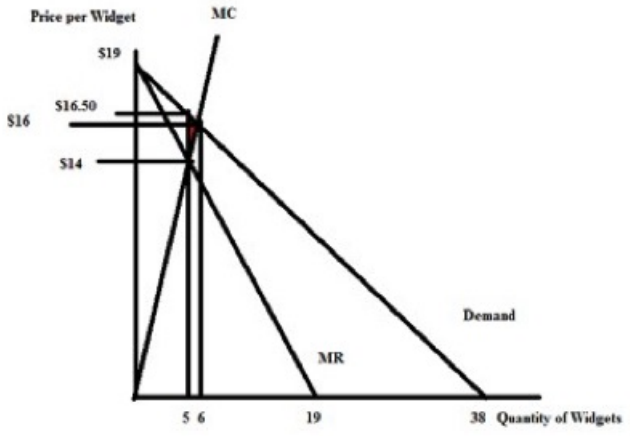
   Solution: This monopolist will continue to earn positive economic profits in the long-run, if there are effective barriers to entry that result in the monopoly continuing to operate as a monopoly and, therefore, be safe from competition.

5. Calculate the deadweight loss that results from this market being served by a monopolist. Show how you found your answer. Provide a graph that is well labeled to illustrate your answer.

   Solution: To find the deadweight loss we need to first figure out the socially optimal amount of the good: this would be the amount of output where MC equals the demand curve since for the last unit of output we have the addition to total cost from producing this last unit is equal to the value the consumer places on consuming the last unit (the price they would be willing to pay).
   So, setting MC equal to the demand curve we have:

   $$4 + 2Q = 19\text{–}(1/2)Q \implies (5/2)Q = 15 \implies Q = 6 widgets$$

   We will also need to find the value of MC when $Q = 6$:
   so, $MC = 4 + 2Q = 4 + 2(6) = \$16$
   Deadweight Loss from the monopoly:
   DWL = (1/2)∗($16.50 per widget - $14 per widget)∗(6 widgets - 5 widgets) = $1.25
   The deadweight loss is shown in the graph below as (the very small) triangle.



Multiple Choice Exercises

Use the following information to answer all multiple choice questions

Consider the market for signed Phoebe Bridgers records. Phoebe has a unique signature that cannot be replicated by anybody else, so she has a monopoly on signed records. However, she has to buy pens and records, and the time she spends signing records could be spent making new music, going on tour, or building her burgeoning recording studio empire, so signing records comes at a cost. Specifically, Phoebe has total cost function $TC = 100 + q^2$ and marginal cost function $MC = 2q$.

1. Suppose that Phoebe has taken an economics course but never learned about monopoly, so she prices signed records as if she were in a perfectly competitve market. If demand for signed Phoebe Bridgers records is $P_D = 100 - 2Q_d$, what price would she charge, and how many signed records would she sell?

   (a) $P = 20$, $Q = 10$
   (b) $P = 80$, $Q = 10$
   (c) $P = 50$, $Q = 25$
   (d) $P = 25$, $Q = 50$

   Solution: Firms in perfectly competitive markets set price equal to marginal cost. Thus, Phoebe would set $P_D = MC$, where $q = Q_D$. $100 - 2Q_D = 2Q_D$ solves to $Q = 25$. Plugging this back into the demand curve yields a price of \$50. Thus, the answer is (c).

2. Now suppose that Phoebe's friend and fellow musician Julien, who has been reading economics textbooks in her spare time, teaches Phoebe about monopolies. What price will Phoebe charge to maximize her profit, and how many signed records will she sell at that price?

   (a) $P = 68$, $Q = 16$
   (b) $P = 50$, $Q = 25$
   (c) $P = 80$, $Q = 10$
   (d) $P = 60$, $Q = 20$

   Solution: Monopolists maximize profit by setting marginal cost equal to marginal revenue, which is the same as the demand curve (with P

on the left hand side), but with a slope that's twice as steep. To find the answer, then, you solve $100 - 4Q = 2Q$ *for* Q*, then plug* Q *into the demand curve to determine price. This gives* $Q = \frac{100}{6} \approx 16.67$*. Thus, she will sign 16 records at a price of \$68 per record.*

3. What is the deadweight loss in the market for signed Phoebe Bridgers records that is caused by Julien sharing her knowledge of monopolies with Phoebe?

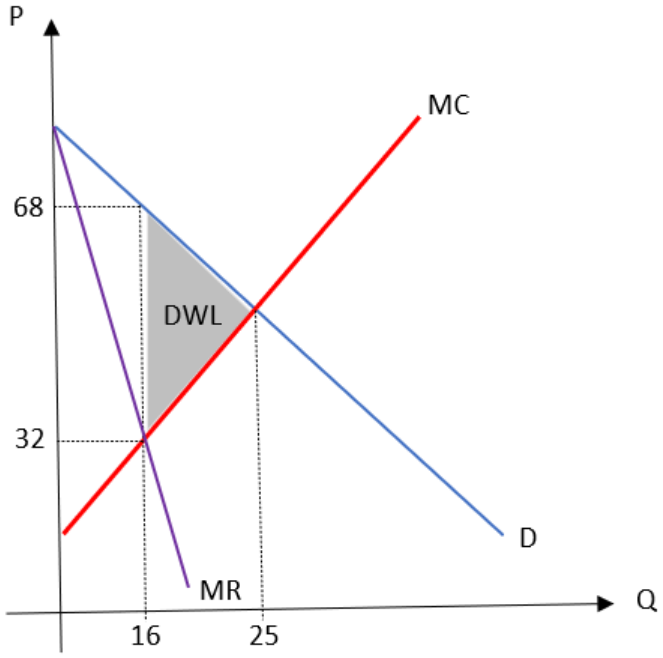
   (a) \$450

   (b) \$81

   (c) \$364

   (d) \$162

   Solution: Deadweight loss is represented by the triangle formed between the demand curve and the marginal cost curve, from $Q = 16$ *to the intersection of the two curves (see the chart below). This triangle has area* $\left(\frac{1}{2}\right)(25 - 16)(68 - 32) = 162$*. Thus, the deadweight loss is \$162, so the answer is (d).*



4. Suppose that then-candidate Joe Biden vowed that he would minimize all deadweight loss from musicians' monopolies on signed records. What price ceiling should President-elect Biden enact to minimize deadweight loss from Phoebe's monopoly?

   (a) $50

   (b) $25

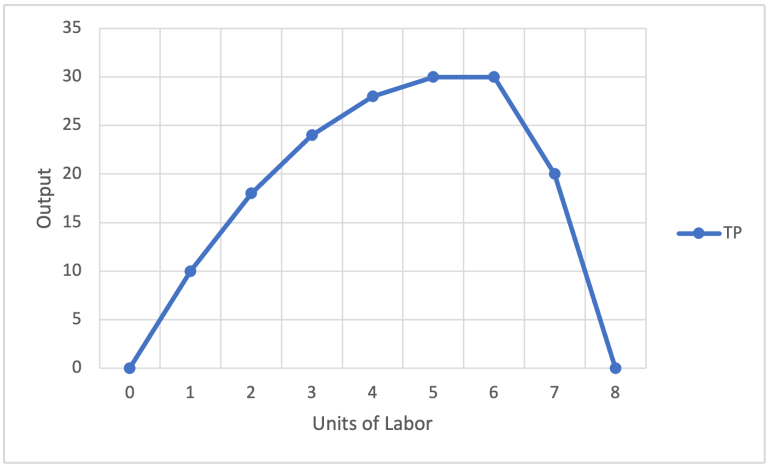
   (c) $0

   (d) $68

   Solution: Deadweight loss from a monopoly can be eliminated by enacting a price ceiling equal to the price at which marginal cost is equal to the demand curve. In this case, we solved this value as $50 in question 1. Thus, the answer is (a).

Difficult Exam Questions

1. Question 13: The graph below describes the Total Product (TP) of labor for a firm. Use this graph to answer the question:



13.png

   I. The graph is consistent with the law of diminishing marginal returns.

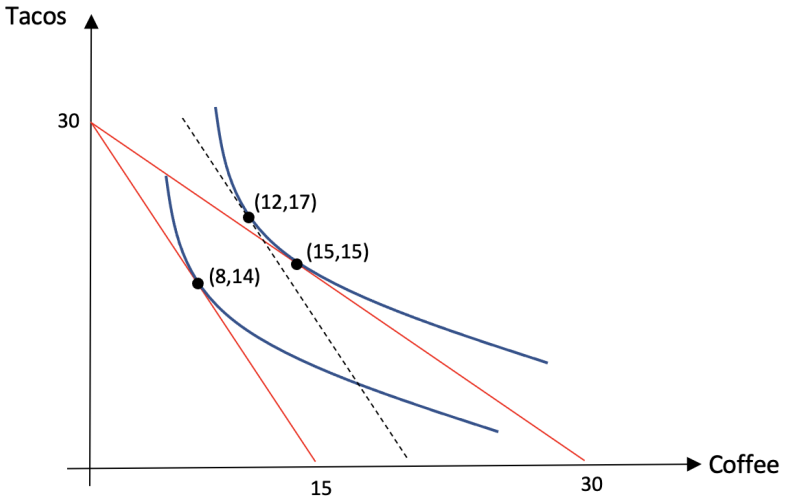
   II. The MPL curve is constant.

   III. The MPL curve intersects with the APL curve somewhere between 2 and 6 units of labor.

      a. I only.
      b. I and II only.
      c. I and III only.
      d. All of the above.

Solution: MPL is given by the slope of the TP. Clearly, the slope of TP is decreasing from the very beginning as units of labor increases. So (I) is true, i.e. MPL is diminishing.
Since MPL is decreasing, it is not constant – so (II) is not true.
For the first 6 units of labor, TP is increasing but at a decreasing rate. Thus, the MPL is decreasing. In this region, the APL is always above the MPL curve. Note the definitions: $MPL = \frac{\Delta TP}{\Delta L}; APL = \frac{TP}{L}$. *Hence, (III) is not true.*
Therefore, the correct answer is (a).

Use the information below to answer questions 4-6. Like most economics graduate students, Danny consumes truly egregious amounts of coffee. However, he cannot live off of coffee alone, so he also consumes tacos. The chart below displays Danny's consumption behavior before and after a price change. Danny's income is \$60 and he consumed 15 cups of coffee and 15 tacos before the price change.



6.png

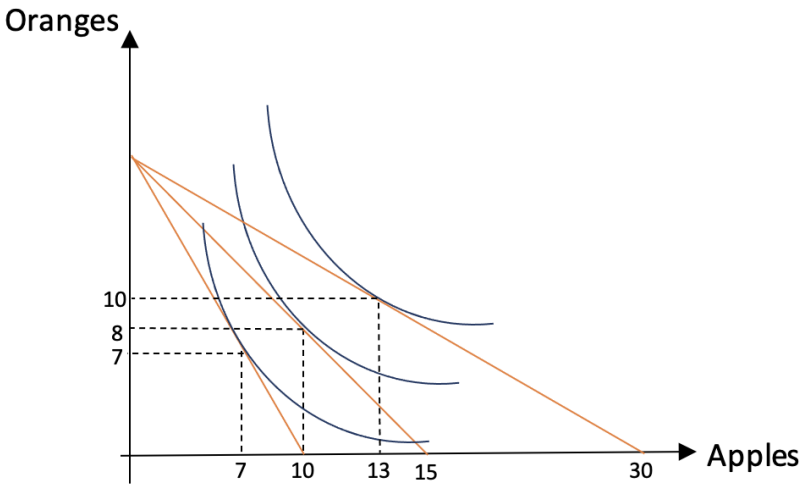
2. Question 6: Suppose that Professor Hansen recognizes Danny's need for coffee and wants to pay him to offset the price change. How much would Professor Hansen have to pay Danny in order to make him as happy as he was before the price change?

   a. \$22
   b. \$30
   c. \$15
   d. \$18

   Solution: Here, since the decomposition basket and the consumption basket with the old prices are on the same indifference curve, Prof. Hansen has to pay Danny the amount that will allow Danny to afford the decomposition basket given the new prices. The new prices are $P_C = \frac{\$60}{15} = \$4$ *and* $P_T = \frac{\$60}{30} = \$2$.

Thus, the decomposition basket costs $12 \times \$4 + 17 \times \$2 = 82$.
Since Danny requires $\$(82 - 60) = \$22$ *extra money to afford the decomposition basket, the correct answer here is (a).*

Use the information below to answer questions 1-3. Jamelle consumes apples (x) and oranges (y). The graph below displays Jamelle's consumption of apples and oranges when the price of apples is \$1, \$2, and \$3.



2.png

3. Question 2: What is the substitution effect for oranges when the price of apples increases from \$1 to \$2?

   a. Impossible to determine.
   b. -1
   c. -2
   d. 2

   Solution: Here, the correct answer is option (a) because we do not have decomposition baskets provided that would have allowed us to dissociate price effect (which is observable) into income and substitution effect.

Use the information below to answer questions 20-23.

Archaeologists excavating at Persepolis, a city of The Achaemenid Empire, have stumbled upon a document during their expedition. They are of the belief that the document represents daily cost estimates of a small profit-maximizing perfectly competitive firm that made clay pots. Since some information on the document has faded away, you are asked to help make sense of the document presented below. Costs are expressed in the local currency, Daric (D).

Quantity	Marginal Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Total Cost
0	–	–	–	–	10
1	26	**10**	**26**	**36**	**36**
2	16	**5**	**21**	**26**	**52**
3	18	**10/3**	**20**	**70/3**	**70**
4	**30**	**2.5**	**22.5**	**25**	100

4. Question 23: How would the firm react if the market price changed to 18 D in the short run?

   a. Shut down operations.

   b. Reduce production to 3 units.

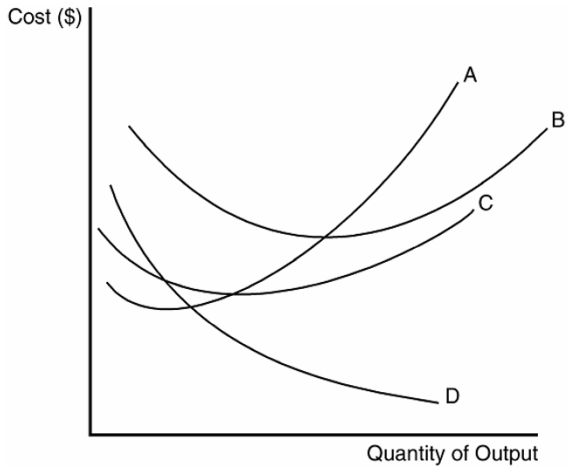
   c. Reduce production to 2 units.

   d. Reduce production to 1 unit.

   Solution: A profit-maximizing firm wants to produce the quantity for which $P = MC = 18D$. *But, at this price,* $P = 18 < 70/3 = \min AVC$. *Thus the firm would want to shut down its operations as it cannot even cover its variable costs at this price. Thus, the correct answer is (a).*

Use the information below to answer questions 11-12.

The curves below reflect information on the cost structure of a firm.



12.png

5. Question 12: Curve A is U-shaped (first decreasing, then increasing) because of

   a. the fact that decreasing marginal product follows increasing marginal product.
   b. economies of scale
   c. constant returns to scale
   d. diminishing marginal product

   Solution: The correct answer is (a) because the initial reduction in average costs comes from increasing marginal product of inputs whereas the latter increase in those costs comes from decreasing marginal product.
   A lot of students answered (d), but the initial increase in marginal product disqualifies that answer.

Use the information below to answer questions 26-27.

Suppose the market for computers is perfectly competitive. There are 24 identical firms in the market and each firm has cost functions as follows:

$$TC = q + 3q^2 + 34$$
$$MC = 1 + 6q$$

The demand for computers is given by

$$P = 86 - Q$$

6. Question 27: In the long run, the number of firms in the market
   a. would decrease.
   b. would increase.
   c. would remain unchanged.
   d. may increase, decrease, or remain unchanged.

Solution: In Question 26, we find that the short-run equilibrium price is \$18.
Substituting that into the demand function, we get $Q^* = 86 - P^* = 86 - 18 = 68$. *Given 24 identical firms, a representative firm would produce* $q^* = \frac{68}{24}$ *units.*
At that price, a representative firm would have $TR = P \times q^* = 18 \times \frac{68}{24} = 51$ *whereas* $TC = \frac{68}{24} + 3 \cdot \left(\frac{68}{24}\right)^2 + 34 = 60.92$.
Since there are losses in the short run for a representative firm, some firms will exit the market in the long run, leading to a lower number of firms in the industry. Hence, the correct answer is (a).

Use the information below to answer question 29.

Phoebe hires musicians (L), and purchases studio equipment (K) to produce indie records that sell at \$2 each. The table below displays the marginal product of labor that Phoebe faces, as she hires musicians (L).

L	MP_L	$MRP_L = MP_L \times P_x$
1	2	**4**
2	5	**10**
3	10	**20**
4	8	**16**
5	6	**12**
6	4	**8**

7. Question 29: If the musician's wage is \$10, how many musicians should Phoebe hire to maximize her profit?

   a. 5

   b. 2

   c. 1

   d. 4

   Solution: Phoebe will want to keep hiring musicians as long as $MRP_L \geq P_L = 10$. *It holds until the unit of labor equals 5.*
   Option (b) i.e. hiring 2 musicians is a tempting choice as $MRP_L = P_L = 10$ *at that point. But we can clearly see that Phoebe will increase her profits if she hires a 3rd musician, so hiring just 2 people cannot be the profit maximizing choice.*
   We can continue this reasoning to see that it is not worthwhile to hire the 6th musician as Phoebe would have to pay \$10 to the musician while increasing her revenue by only \$8, and thus lowering her profits. Thus, the optimal choice is hiring 5 musicians i.e. option (a).

Use the information below to answer questions 16-19.

Suppose that the hotdog stand industry in Madison is perfectly competitive with identical firms. Each firm's costs are summarized as follows:

$$TC = 3q^2 + q + 12$$
$$MC = 6q + 1$$

The demand for computers is given by

$$P = 17 - Q$$

8. Question 18: Calculate the profits for the representative competitive firm in the short run.

   a. \$0
   b. -\$12
   c. \$12
   d. \$26

   Solution: This question is part of a three-part question. In Question 16, you get that the equilibrium price is \$13 and in Question 17, you get that 2 firms will produce in the short run.
   With $P = 13$*, we can use the demand curve to get* $Q = 4$ *and since there are two firms:* $q = 2$*. Then, total revenue for each firm is* $P \times q = \$13 \times 2 = \$26$ *whereas the Total Costs* $= 3(2)^2 + (2) + 12 = 26$*. Since* $TR = TC$*, a representative firm makes 0 profits. Hence, the correct answer is (a).*